

Appreciating Faith And Culture In An Age Of Scientific Reasoning. On Constructive-Critical Realism

„Faith and reason are like two wings on which the human spirit rises to the contemplation of truth.“¹

1. The Common Search For Truth

Theology does not always regard the development of science as relevant for its argumentation. Yet outside the walls of church communities, scientific –especially evolutionary – thinking dominates the everyday philosophies of many people. Also for the scientists themselves, science is often thought to be more than just a technical approach to establish empirical observations that work. Although interpretations may vary, what generally is at stake since the case of Galilei is the question of *truth*, of revealing the way the world we live in really is. Should not at least a theology of creation regard what science finds out about this world?

On the one hand it may make sense, to think theology through based on what it can learn from science. The so-called “science and religion” discourse attempts at that. On the other hand, one must show why faith and culture are still relevant in a world dominated by scientific reasoning. I am convinced, this second aspect is not sufficiently covered by how the science and religion discourse is mostly performed in theology until today. Faith does play a crucial role, but culture not so much.

For instance, former professor of particle physics (and later Anglican priest) John Polkinghorne speaks of *both* science and theology as truth-seeking communities. From a philosophical point of view, this presents a metaphysical interpretation of science as a *verisimilitudinous* endeavor, approaching the one world’s reality with our scientific efforts. If we do assume for the moment the underlying *scientific realism* as adequate, we must ask the base question of the modern science and religion discourse, if one can compare the domains of science and theology at all. We will hence reconstruct in the following sections the history and assumptions of this discourse to understand its achievements, but also to analyze its shortcomings in theology until today.

2. The Idea Of A Critical Realism

Highly influential for this discourse was a statement from Alfred North Whitehead, the Harvard philosopher who wrote in *Religion in the Making*:

“The dogmas of religion are the attempts to formulate in precise terms the truths disclosed in the religious experience of mankind. In exactly the same way, the dogmas of physical science are the attempts to formulate in precise terms the truths disclosed in the sense–perception of mankind.”²

With this surprising parallelism, he inspired not only John Polkinghorne, but also the pioneer of the modern science and religion discourse, Ian G. Barbour, to advocate the same

epistemology in *both* science and religion, an approach called *critical realism*, allowing “for the role of both subject and object in knowledge.”³ In his *Issues in Science and Religion* (1966), Barbour assumes science to be located more at the objective end of the spectrum of knowledge, while religion is imagined to be more at its subjective end. For Barbour, there is always a subjective *and* an objective component involved. “Both scientific and religious language are realistic and referential in intent”,⁴ as Barbour reflects Whitehead’s keen statement. Both do perform truth claims.⁵

And both contain an element of faith. Besides Whitehead, both Barbour and Polkinghorne make much use of a chemist turned philosopher-of-science named Michael Polanyi. In his analysis of how science works, he also questioned positivism. He was convinced that personal knowledge⁶ is involved in the scientific process, even that *faith* played a key role; not so much the faith of the church, but the fiduciary capacity of researchers to follow their visions. Nevertheless, he went so far to describe this capacity with the church father’s motto “faith seeking understanding”.⁷ The claim for comparability or for a parallel process of knowing in science and religion/theology is better understood with such a conviction in mind. The idea of a critical realism in both science and religion/theology relies much on Whitehead’s and Polanyi’s philosophical considerations.

3. Common Ground Or Separate Territories?

Responding to Paul Tillich’s theology, Michael Polanyi spoke of the “common ground” of science and religion. “I believe that our knowledge of nature yet has a bearing on our religious beliefs: that, indeed, some aspects of nature offer us a common ground with religion.”⁸ As being said, the common necessity of *faith*, the participation of the knower in all processes of knowledge, was his claim and creed.

Usually, and in contrast to Polanyi’s point of view, science and religion are often regarded as *separate endeavors*, as prominently presented by Steven J. Gould’s NOMA approach, for instance.⁹ There are reasons for it. History proved that earlier attempts to grant God the glory to act as a cause within the fabric of the world, for instance Newton’s idea of a Divine Hand, “which held the planets on course against the gravitational pull of the sun despite frictional loss”,¹⁰ later had to be discarded. Immanuel Kant therefore already wisely avoids interference by God with nature by praising God as the giver and preserver of the order of the very laws of nature.¹¹ Theologically, Dietrich Bonhoeffer later equally pointed out the problem of the concept of a God of the Gaps.¹² There are indeed *many* reasons to keep this separation between science and religion in mind.

Not so much, because the two domains are fighting with each other. Disregarding for the time being the loudly voiced and sociologically interesting, but not very representative¹³ views of creationists on the one side and science ideologists on the other side, the popular idea of a modern *conflict* between science and religion¹⁴ is a myth. It may even present a result of the modern conceptualization of these terms, as historian of science Peter Harrison suggests. Science and religion “are neither universal propensities of human beings nor necessary features of human societies. Rather they are ways of conceptualizing certain human activities – ways that are peculiar to modern Western culture, and which have arisen as a consequence of unique historical circumstances.”¹⁵ Were the question of the relationship

between science and religion put to Thomas Aquinas, for instance, “There would then have been no question of conflict or agreement between science and religion because they were not the kinds of things that admitted those sorts of relations.”¹⁶ Is also assuming “common ground” too far-fetched, then?

For more *theological* than philosophical reasons, also the influential modern “church father” Karl Barth imagined a separation of the disciplines, marked with the famous words:

“There is free scope for natural science beyond what theology describes as the work of the Creator. And theology can and must move freely where science which really is science, and not secretly a ... religion, has its appointed limit.”¹⁷

It is therefore historically, philosophically and theologically quite adequate to hold this separation in mind.

4. Why Should And How Could Theology Deal With Science?

Why, then, argue for an involvement of theology with science? I believe it of utmost importance in times of “two cultures” (C.P. Snow) to take care of their interaction, if we believe this *one world* we live in to have been created by *one God*. Faithful believers and informed philosophers alike are aware that the separation to some degree is something artificial, a human construction imposed on one world, which may on the one hand serve the purpose of furthering departmental in-depth-research, with the cost, on the other hand, of losing the greater picture of our reality out of sight.

Thomas F. Torrance, who later edited the English translation of Karl Barth’s *Church Dogmatics*, was a despiser of such a dualism. Regard in his following statement, while being similar to Barth’s quote, one important difference to Barth:

“Science only informs us what light is thrown upon reality by the empirical observation of the facts of external nature. When science claims that this is all that can be said, it is no longer science but the species of philosophical theory called naturalism.”¹⁸

The difference lies in the *idea of a common reality* overarching both science and religion. Later, Torrance elaborated his ideas. In his seminal work *Theological Science*, and inspired by German physicist Günter Howe’s embrace of Barth’s theology, Torrance developed a crucial idea of Barth, the concept of the *Sachgemäßheit*.¹⁹ Barth had emphasized that theology must follow its proper logic, reflecting on the rationality of its particular object of study, the gospel alone. Thomas Torrance generalized this: every scientific discipline must follow its proper logic, as every object can only be known with a method *in accordance to its object*. One could hence argue that different scientific disciplines employ different rationalities;²⁰ former physicist Polkinghorne even called Torrance’s idea “congenial to the scientific mind”.²¹

For Torrance, following Augustin, theology requires *belief* as the right “method” to understand it,²² and hence Michael Polanyi’s conviction that belief is an essential component of any scientific knowing, echoed strongly with him. Even Einstein (Torrance’s “scientific hero”, says Polkinghorne), who disliked the idea of a personal God and who advocated in general an *is/ought* divide between science and religion,²³ famously claimed: “science without religion is lame, religion without science is blind”, because “science can only be created by

those who are thoroughly imbued with the aspiration towards truth and understanding”, which would stem from religion.²⁴ And Einstein also spoke, like Polanyi, of a “profound faith” of scientists, in the rationality of the world.

5. Ian G. Barbour’s Insight And What He Did Not See

Similar to the reciprocity Einstein envisioned, Werner Arber, Nobel Laureate and previous President of the Papal Academy of Sciences, is „convinced that scientific knowledge and faith are complementary elements in our orientational knowledge and should remain so.“²⁵ Like here, *orientation* is usually linked to the domain of the humanities and especially of religion. That ethical decisions should be scientifically well informed seems obvious to me. Religion without science is blind indeed.

Is the relation between science and religion then really a *complementary* one, as Arber puts it, or are science and religion even *parallel* endeavours regarding their method, as Whitehead had postulated? The previously mentioned Ian Barbour once also took a complementary stance regarding their relation. He changed his mind, however, because he saw a certain risk with this approach to restrict the religious approach to science to ethical considerations. In his *Issues in Science and Religion*, he regarded science and religion viewed as “complementary languages” still “a valid starting point”, pointing out, however, “that we cannot stop with an absolute separation of spheres” and “that there are significant possibilities for dialogue”.²⁶ His assumptions were at first *significant parallels in methods* of science and religion, which are better understandable if one keeps Polanyi’s and Whitehead’s (and maybe also Einstein’s) remarks in mind. Second, the idea of “one world” – that is *an integrated worldview* – is essential for such deliberations. The program he hence advocated became known as the mentioned “critical realism” and dominated the Anglo-American science and religion discourse for several decades.

Now, although I think Ian Barbour has much in favor of his thesis and made a tremendous contribution being something like the founding father of the 20th century discourse between science and religion, and hence helped saving the role of faith in our scientific culture, I am convinced he overlooked something very important: *the distinct role of the humanities*. *Culture* itself as a realm of its own is missing. Also, is theology normally not perceived as part of the humanities, at least more than part of science? I believe theology is somewhat diminished if reduced to a Barbour-type critical realist concept only. Although one may even make good use of some sort of “critical realism” to describe Karl Barth’s theology,²⁷ I am convinced the concept needs at least to be qualified further to avoid some sort of unwanted physicalist shortcomings.

6. Surprising Support For Critical Realism

The president of the Papal Academy of the *Social* Sciences, Margaret Archer, is a critical realist as well. This may surprise us, the remarks concerning the shortcomings of critical realism regarding the humanities provided. The irritation may fade away the moment one realizes that it was a modern *social* philosopher, Roy Bhaskar, who advocated another version of “critical realism”.²⁸ Diverging from other critical realisms, the term was not coined by him, but applied to his philosophy by others, as a merger of “transcendental realism” and “critical

naturalism". "Such a naturalism holds that it is possible to give an account of science under which the proper and more less specific methods of both the natural and social sciences fall; but it does not deny that there are significant differences in these methods, grounded in real differences in their subject matters and in the relationships in which their sciences stand to them."²⁹

While Ian Barbour endorsed a thesis of a *continuous spectrum* between more subjective humanities and more objective natural sciences,³⁰ followers of the hermeneutical tradition (like Bhaskar) are "correct to point out that the social sciences deal with a pre-interpreted reality". "To put it crudely, the human sciences stand, at least in part, to their subject matter in a subject–subject (or concept–concept) relationship, rather than simply a subject– object (or concept–thing) one."³¹ Even if one takes a hermeneutical approach to science,³² there is sort of a *double hermeneutics* here at stake, so to say.

Bhaskar's philosophy also inherits from this hermeneutical tradition the idea that "it is the nature of the object that determines the form of its possible science".³³ Torrance's and Bhaskar's thoughts seem to converge on this point, as noticed by Oxford theologian Alister E. McGrath.³⁴

7. A Constructive Proposal: Constructive-Critical Realism

I now want to propose an epistemological approach that is aware of the differences between science and humanities which I mentioned. While Barbour's critical realism accounts for the *similarities* between the methods of science and religion, it does not take sufficiently into account the *differences* between the two, which I would like to emphasize with Bhaskar's interpretation of critical realism. To distinguish this approach from plain critical realism à la Barbour, I propose an extension of the term to "constructive-critical realism".

This proposal could also help framing a decade-old discussion, the one between realism and constructivism. My idea is that maybe *to some degree both are right in their emphasis* regarding their respective domains, which in my imagination are the natural sciences for realism and the cultural sciences for constructivism. Of course, I suppose neither a naïve nor an uncritical interpretation of these epistemological stances. With a *constructive-critical realism* I want to grant both constructivism and critical realism their due rights, while sticking to a modified idea of realism.

First, why realism? For me, the realist's "desk-thumping, foot-stamping shout of 'really!'"³⁵ is indeed "not meaningless, but does make deep sense, because without this ever daring leap of faith, no knowledge nor understanding could ever be achieved."³⁶ Truth claims do make sense to me. Second, we may not forget that these are truth *claims*. If there is always a personal element of faith in any science, for the natural sciences, a mostly *critical* view of the personal involvement in the process of science may justifiably dominate, because according to inter-subjective agreement and commitment, the object of study is the impersonal world. Polanyi's "post-critical" philosophy,³⁷ however, wanted more than that, I am convinced. Thirdly, especially in cultural sciences, the degree of personal involvement is too deep to call it simply a "critical" element. Already the "subjective" character of the object of inquiry

demands a higher evaluation of the subject in the process of knowledge. Also, constructivism is right to point out that our subjective reality constructions vary in significant ways, which is of the essence, because it is these cultural reality constructions which are the object of study. The “critical” view of the personal element as a self-critical enterprise with universal intent may dominate in the process of the natural sciences; the “constructive” view of the personal element may dominate in the process of cultural sciences.³⁸ Hence, we need to safeguard these differences with a more differentiated and less ambiguous term than plain critical realism: “constructive-critical realism” is proposed here.

8. Realism And Constructivism About Truth

What is truth? Different theories of truth compete. The classical realist and common-sense position is the *correspondence* view of truth: that “a proposition is true if it corresponds to reality”.³⁹ When it rains, it is true to say so. Science today is, however, a much more complicated endeavor. Not everything can be directly observed; often access to reality is indirect. Hence Ian Barbour’s *critical* realist theory of truth tries to grant also other theories of truth their due weight, the *coherence* and *pragmatic* views. This allows more criteria to assess scientific theories than only via *agreement with data*, that is, also their *coherence*, *scope* and *fertility* (the theory’s promises as a future research program) play a role.

Barbour also shows himself quite aware of Thomas Kuhn’s insights regarding the paradigm-dependence of research (which was *inter alia* inspired by Michael Polanyi⁴⁰). Kuhn’s ideas come close to those employed by constructivists. “In the constructivist way of thinking, the concept of *viability* in the domain of experience, takes the place of the traditional philosopher’s concept of Truth, that was to indicate a ‘correct’ representation of reality.”⁴¹ Something seems viable if it simply *fits the purposive or descriptive contexts in which we use it*. Hence, radical constructivism focuses on the subject in the process of knowing. It “is a way of thinking about knowing and the act of knowing”⁴² and follows two basic principles:

- “knowledge is not passively received but built up by the cognizing subject;
- The function of cognition is adaptive and serves the organization of the experiential world, not the discovery of ontological reality.”⁴³

Now, if we recall Michael Polanyi’s insights, already critical realists are aware of the “constructive role of the subject”,⁴⁴ although in my view they often do not distinguish sufficiently between the fields of study. The first constructivist principle they can nevertheless agree on, and regarding the second principle: is constructivism’s negative statement concerning “discovering reality” really justified? How do constructivists *know* that our organization of the experiential world does *not* match the world out there? Sure, everybody’s construction of reality may be slightly different. But maybe there is enough to agree on to assume such an ontological reality. Also, even radical constructivists are empirical realists.⁴⁵

Viewed in this way, the denial of discovery may be itself a non-empirical and unnecessary *metaphysical commitment*. Still, I think constructivists are quite right in two regards: 1) every individual world construction may indeed differ and will differ from another person’s point of view. 2) Scientific realism is itself a *belief*, although I would say it is one that *works*, because to some degree it partially corresponds to the reality of the world, of which we are part.

9. The Cultural Dimension Of Constructive-Critical Realism

Whatever we discover in research, we also change. What is true for the miniscule scales of the quantum world, is also true for the mesocosmic world we relate to. Realism is a very appropriate stance to remind us of this entanglement of humankind with nature. Philip Hefner's idea of humans as "created co-creators" wants to express a similar thought, and additionally it elucidates the reality of *culture*. "It 'refers to the emergence of a creature, Homo sapiens, (1) who on the one hand is thoroughly a creature of nature and its processes of evolution—hence the term created—and (2) who at the same time is created by those very processes as a creature of freedom.' Freedom is meant here to describe the condition of existence in which humans unavoidably face the necessity both of making choices that govern their behavior and of constructing stories that contextualize and hence justify their choices: creating culture."⁴⁶

We need to integrate this insight of another famous proponent of the science and religion discourse into our epistemological approach. Biblically speaking, culture can be portrayed as an essential element of creation; man's making of the tent of the covenant mirrors God's making of the world (cf. Gen 1 with Ex 24ss).⁴⁷ By means of culture, human beings take part in the world's *continuous creation*. According to the constructive-critical realism proposed here, it is humankind's mission and purpose *to shape nature in creative and responsible participation in God's creation and with the means of culture toward increasing realization of freedom in relationship (which is love)*.

In the spirit of love, we also feel easier to admit that *the* truth is with God, and we do not own the truth. Not presuming to be like God and to know the truth in my eyes is "the beginning of wisdom" (Ps 111:10). We humans must be aware that we are never grasping the whole story of what is going on, cannot employ a god's-eye view and hence the fragmentary character of our perception needs to be clear and conscious, while we are responsible to the whole of reality,⁴⁸ acknowledging that "we are men, not God; we are responsible for making choices between greater and lesser evils."⁴⁹ What we can do, are motivated truth claims, and I am convinced our constructive role in them is better expressed by a constructive-critical realist stance. Even more, most important is if we live up to our truth claims and validate them by our lives. Creating a culture of love, we can be of use to heal the world, I am convinced.

Also in the process of science (and in its application as well), cultural construction carrying ethical decisions is taking place. If we admit with critical realism that the subject plays a substantial role in any research, this also means that *values* are of importance here as well. The ideal value-freeness of research is only one (highly important) value amongst others. A participatory epistemology like ours, however, demonstrates the need for ethical commitment in science and technology and all other aspects of culture as well. Ian Barbour was a pioneer in these regards, too,⁵⁰ but in my view his epistemic considerations on critical realism unfortunately did not integrate this aspect sufficiently. I am convinced, *epistemology and ethics need to be merged* when dealing with our future on Earth.

10. What Does This All Mean For Believers?

How, finally, should theology and the church relate to "constructive-critical realism"? The adequacy of a critical realism for theological research as a parallel to scientific realism has

prominently been doubted.⁵¹ Nevertheless, as the Creator of all reality is prior to all human knowledge, I believe realism in general to be a good start for theology, too. I think it is indeed a reward of the science and theology debate to show that also theology has a rationality, one of its own, which incorporates impersonal, personal and transpersonal elements. “Therefore, to ‘re-search’ God, one needs to regard both elements presented, the constructive and the critical one. Where it comes to knowledge, one has to recall critically God’s transcendence and the sin separating us from God.” His ways may be hidden to us as the subtleties of the quantum world. Also, “we have to discern our own projections of God (resulting from our wish to be like God) from his self-revelation. This is where Feuerbach is right.” I must say, in my experience unfortunately exactly those that consider themselves the most pious ones are especially endangered to conflate their interpretation of the Bible with God’s Word itself. Also, in congregational or denominational conflicts and policies, we have to recall that our fundamental assumptions are *beliefs* of a certain certitude, yet no secure knowledge; this, the idea of a critical realism does point out, but a constructive-critical realism (emphasizing the role of culture in our knowing) even more so. It adds the insight that our divergent creeds and congregational rules are cultural constructions from our individual or communal perspective, and only a share of the truth we strive for. Besides, the constructive element adds something even more important: “where it comes to deeds, we are asked to cooperate constructively with God according to his revealed will, making his immanence present all through the world.”⁵² The proof for theological contemplations therefore lies not in our confessions nor correspondence claims, but in our truthful actions. Again, what is truth? For Christians, Christ is “the way, and the truth and the life” (John 14:6). I would say this truth is about the belief in a certain *way of life*, validating the Divine love with our lives. We need not worry how we could ever *know* the truth. A truthful life can be our answer. “Console thyself, thou wouldst not seek Me, if thou hadst not found Me.”⁵³ Though the Christian experiment’s proof demands a participatory involvement with Christ as the object of one’s search, one must acknowledge that this object is a *subject*, the Divine Other who himself grants us the opportunity to get known to him. God is love, and the highest commandment is the twin commandment of love, not hateful self-righteousness. We shall love, know and take care of our corner of the cosmos as we are known and loved by him who created everything, and ourselves in his image. Of this, I am certain.

Bibliography

- Barbour, Ian G. *Issues in science and religion*. Englewood Cliffs N.J.: Prentice-Hall, 1966.
- . *Myths, models and paradigms: The nature of scientific and religious language*. London: S.C.M. Press, 1974.
- . *Religion in an age of Science*. 1. publ. The Gifford lectures 1989-1991, 1. London: SCM Press, 1990.
- . *Ethics in an age of technology*. 1. HarperCollins ed., 2. [print.]. The Gifford lectures 1989-1991, 2. New York NY: HarperSanFrancisco, 1994.
- . *Nature, human nature and God*. Theology and the sciences. Minneapolis Minn.: Fortress Press, 2002.
- Bhaskar, Roy. *The possibility of naturalism: A philosophical critique of the contemporary human sciences*. Harvester philosophy now. Brighton: The Harvester Press, 1979.
- Bonhoeffer, Dietrich, Christian Gremmels, and Eberhard Bethge, eds. *Widerstand und Ergebung: Briefe und Aufzeichnungen aus der Haft*. Werke / Dietrich Bonhoeffer. Hrsg. von Eberhard Bethge ...; Bd. 8. München: Kaiser, 1998.
- Clayton, Philip. *Explanation from physics to theology: An essay in rationality and religion*. New Haven, Conn.: Yale University Press, 1989.

- Dick, Steven J. *Plurality of worlds: The origins of the extraterrestrial life debate from Democritus to Kant*. Cambridge: Cambridge Univ.Pr, 1982.
- Draper, John William. *History of the conflict between religion and science*. American Culture Series, Sciences collection reel 1:13. New York: D. Appleton, 1875.
- Ecklund, Elaine Howard. *Science vs. religion: What scientists really think*. New York, Oxford: Oxford University Press, 2010.
- Einstein, Albert. "Science and Religion." *Nature*, Nov. 9 (3706) (1940).
- Fine, Arthur. "The Natural Ontological Attitude." In *Scientific realism*. Edited by Jarrett Leplin, 83–107. Berkeley Calif. u.a.: Univ. of California Pr, 1984.
- Glaserfeld, Ernst von. *Radical constructivism: A way of knowing and learning*. Studies in mathematics education series 6. London, New York: Routledge/Falmer, 2002.
- Gould, Stephen Jay. "Nonoverlapping Magisteria." *Natural History*, 106 (March) (1997): 16–22.
- Harrison, Peter. *The territories of science and religion*. Chicago, London: The University of Chicago Press, 2015.
- Hefner, Philip. "Biocultural Evolution and the Created Co-Creator." In *Science and theology: The new consonance*. Edited by Ted Peters, 174–88. Boulder, Colo.: Westview Press, 1998.
- Jammer, Max. *Einstein and religion: Physics and theology*. Princeton, NJ, Chichester: Princeton University Press, 1999.
- John Paul II. "ENCYCLICAL LETTER FIDES ET RATIO." Accessed August 1, 2017.
http://w2.vatican.va/content/john-paul-ii/en/encyclicals/documents/hf_jp-ii_enc_14091998_fides-et-ratio.html.
- Kant, Immanuel. *Natural Science: translated and edited by E. Watkins et al*. Cambridge: Cambridge University Press., 2012.
- Karl Barth. *Church dogmatics. Volume 3: The Doctrine of Creation: Part 1*. Edinburgh: T & T Clark, 1958.
- Kuhn, Thomas S. *The structure of scientific revolutions*. 2nd ed. Chicago: Chicago University Press, 1970.
- La Montagne, D. Paul. *Barth and rationality: Critical realism in theology*. Eugene OR: Cascade Books, 2012.
- Losch, Andreas. "Our world is more than physics: A constructive – critical comment on the current science and theology debate." *Theology and Science* 3, no. 3 (2005): 275–90. doi:10.1080/14746700500317271.
- . "On the Origins of Critical Realism." *Theology and Science* 7, no. 1 (2009): 85–106. doi:10.1080/14746700802617105.
- . "Critical Realism—A Sustainable Bridge Between Science and Religion?" *Theology and Science* 8, no. 4 (2010): 393–416. doi:10.1080/14746700.2010.517638.
- McCormack, Bruce L. *Karl Barth's critically realistic dialectical theology: Its genesis and development 1909-1936*. Oxford: Clarendon Press, 1995.
- McGrath, Alister E. *T.F. Torrance: An intellectual biography*. Edinburgh: T & T Clark, 1999.
- . *A scientific theology: Vol. 2: Reality*. T & T Clark theology. London, New York: T & T Clark, 2006.
- McMullin, Ernan. "Realism in Theology and Science: A Response to Peacocke." *Religion & Intellectual Life*, 2/4 (1985): 39–47.
- Mühling, Markus. *Einstein und die Religion: Das Wechselverhältnis zwischen religiös-weltanschaulichen Gehalten und naturwissenschaftlicher Theoriebildung Albert Einsteins in seiner Entwicklung*. Religion, Theologie und Naturwissenschaft. Göttingen: Vandenhoeck & Ruprecht, 2011.
- Niebuhr, H. Richard. *The responsible self: An essay in Christian moral philosophy*. 1st ed. New York: Harper & Row, 1963.
- Niebuhr, Reinhold. *Faith and politics: A commentary on religious, social, and political thought in a technological age*. New York: Braziller, 1968.
- Polanyi, Michael. *Personal knowledge: Towards a post-critical philosophy*. Chicago Ill.: Univ. of Chicago Press, 1958.
- . "Science and Religion: Separate Dimensions or Common Ground?" *Philosophy Today*, no. 1 (1963): 4–14.
- Polkinghorne, John. *Belief in God in an age of science*. The Terry lectures *. New Haven u.a.: Yale Univ. Pr. [u.a.], 1998.
- Scott, William Taussig, and Martin X. Moleski. *Michael Polanyi: Scientist and philosopher*. New York NY u.a.: Oxford Univ. Press, 2005.
- Torrance, Thomas Forsyth. *Belief in science and in Christian life: The relevance of Michael Polanyi's thought for Christian faith and life*. Edinburgh: Handsel Press, 1980.

Welker, Michael. "Creation: Big Bang or the Work of Seven Days?" *Theology Today*, July (1995): 173–87.

Werner Arber. "Contemplation on the Relations Between Science and Faith." Accessed August 1, 2017.
<http://www.casinapioiv.va/content/accademia/en/academicians/ordinary/arber/contemplation.html>.

White, Andrew Dickson. *The warfare of science with theology in Christendom*. S.l.: King, 1876.

Whitehead, Alfred North. *Religion in the making*. Living age books LA28. New York: Meridian Books, 1960, c1954.

¹ John Paul II, "ENCYCLICAL LETTER FIDES ET RATIO," accessed August 1, 2017, http://w2.vatican.va/content/john-paul-ii/en/encyclicals/documents/hf_jp-ii_enc_14091998_fides-et-ratio.html.

² Alfred North Whitehead, *Religion in the making*, Living age books LA28 (New York: Meridian Books, 1960, c1954), 58. One should consider, however, what Whitehead's understanding of God is, before embracing this too quickly.

³ Ian G. Barbour, *Issues in science and religion* (Englewood Cliffs N.J.: Prentice-Hall, 1966), 206.

⁴ Ibid., 4.

⁵ One should note that while Barbour more has religious scientists and religious communities in mind and hence speaks of "religion", Polkinghorne is more interested in the academic discipline (in which he himself has been trained), and hence speaks of "theology". For the sake of developing our argument, we will draw here both on authors relating to religion in general as on those relating to theology, following their respective terminology, although our own argument favors the academic discourse with theology as a more adequate endeavor.

⁶ Michael Polanyi, *Personal knowledge: Towards a post-critical philosophy* (Chicago Ill.: Univ. of Chicago Press, 1958).

⁷ Nevertheless, Michael Polanyi for the most time of his life was not very religious, see William Taussig Scott and Martin X. Moleski, *Michael Polanyi: Scientist and philosopher* (New York NY u.a.: Oxford Univ. Press, 2005)

⁸ Michael Polanyi, "Science and Religion: Separate Dimensions or Common Ground?," *Philosophy Today*, no. 1 (1963): 4.

⁹ Stephen J. Gould, "Nonoverlapping Magisteria," *Natural History*, 106 (March) (1997)..

¹⁰ Steven J. Dick, *Plurality of worlds: The origins of the extraterrestrial life debate from Democritus to Kant* (Cambridge: Cambridge Univ.Pr, 1982), 145ff.

¹¹ Immanuel Kant, *Natural Science: translated and edited by E. Watkins et al.* (Cambridge: Cambridge University Press., 2012), 1:228. Also already in ibid., 58, 1:62.

¹² Dietrich Bonhoeffer, Christian Gremmels and Eberhard Bethge, eds., *Widerstand und Ergebung: Briefe und Aufzeichnungen aus der Haft*, Werke / Dietrich Bonhoeffer. Hrsg. von Eberhard Bethge ...; Bd. 8 (München: Kaiser, 1998), 454.

¹³ Elaine Howard Ecklund, *Science vs. religion: What scientists really think* (New York, Oxford: Oxford University Press, 2010).

¹⁴ John William Draper, *History of the conflict between religion and science*, American Culture Series, Sciences collection reel 1:13 (New York: D. Appleton, 1875); Andrew Dickson White, *The warfare of science with theology in Christendom* (S.l.: King, 1876).

¹⁵ Peter Harrison, *The territories of science and religion* (Chicago, London: The University of Chicago Press, 2015), 194.

¹⁶ Ibid., 16.

¹⁷ Karl Barth, *Church dogmatics. Volume 3: The Doctrine of Creation: Part 1* (Edinburgh: T & T Clark, 1958), ix f. Important is also the less often cited continuation of this quote: «I am of the opinion, however, that future workers in the field of the Christian doctrine of creation will find many problems worth pondering in defining the point and manner of this twofold boundary.»

¹⁸ Alister E. McGrath, *T.F. Torrance: An intellectual biography* (Edinburgh: T & T Clark, 1999), 201, quoting Torrance in his early Auburn lectures in New York State. The final section of these lectures uses thoughts of Martin Buber, Torrance discovered Polanyi only later.

¹⁹ Andreas Losch, "Critical Realism—A Sustainable Bridge Between Science and Religion?," *Theology and Science* 8, no. 4 (2010): 406, doi:10.1080/14746700.2010.517638.

²⁰ Already within physics alone, there are different rationalities, as quantum physics does not follow the classical-logical *tertium non datur*, for instance; at least according to eminent interpreters of it, like Carl Friedrich von Weizsäcker und Werner Heisenberg.

²¹ John Polkinghorne, *Belief in God in an age of science*, The Terry lectures * (New Haven u.a.: Yale Univ. Pr. [u.a.], 1998), 81.

²² Thomas Forsyth Torrance, *Belief in science and in Christian life: The relevance of Michael Polanyi's thought for Christian faith and life* (Edinburgh: Handsel Press, 1980), 4.

²³ More on Einstein's religion see Max Jammer, *Einstein and religion: Physics and theology* (Princeton, NJ, Chichester: Princeton University Press, 1999). A more thorough going study is Markus Mühling, *Einstein und die Religion: Das Wechselverhältnis zwischen religiös-weltanschaulichen Gehalten und naturwissenschaftlicher*

Theoriebildung Albert Einsteins in seiner Entwicklung, Religion, Theologie und Naturwissenschaft (Göttingen: Vandenhoeck & Ruprecht, 2011).

²⁴ Albert Einstein, "Science and Religion," *Nature*, Nov. 9 (3706) (1940): 605.

²⁵ Werner Arber, "Contemplation on the Relations Between Science and Faith," accessed August 1, 2017, <http://www.casinapioiv.va/content/accademia/en/academicians/ordinary/arber/contemplation.html>.

²⁶ Barbour, *Issues in science and religion*, 4. Later, he explained more detailed his concerns about the complementarity approach, see Ian G. Barbour, *Myths, models and paradigms: The nature of scientific and religious language* (London: S.C.M. Press, 1974).

²⁷ Bruce L. McCormack, *Karl Barth's critically realistic dialectical theology: Its genesis and development 1909-1936* (Oxford: Clarendon Press, 1995); D. Paul La Montagne, *Barth and rationality: Critical realism in theology* (Eugene OR: Cascade Books, 2012).

²⁸ Andreas Losch, "On the Origins of Critical Realism," *Theology and Science* 7, no. 1 (2009), doi:10.1080/14746700802617105.

²⁹ Roy Bhaskar, *The possibility of naturalism: A philosophical critique of the contemporary human sciences*, Harvester philosophy now (Brighton: The Harvester Press, 1979), 3.

³⁰ Cf. Losch, "Critical Realism—A Sustainable Bridge Between Science and Religion?"

³¹ Bhaskar, *The possibility of naturalism*, 27.

³² Like, e.g. Philip Clayton, *Explanation from physics to theology: An essay in rationality and religion* (New Haven, Conn.: Yale University Press, 1989).

³³ Bhaskar, *The possibility of naturalism*, 3

³⁴ Alister E. McGrath, *A scientific theology: Vol. 2: Reality*, T & T Clark theology (London, New York: T & T Clark, 2006).

³⁵ Arthur Fine, "The Natural Ontological Attitude," in *Scientific realism*, ed. Jarrett Leplin (Berkeley Calif. u.a.: Univ. of California Pr, 1984), 97.

³⁶ Andreas Losch, "Our world is more than physics: A constructive – critical comment on the current science and theology debate," *Theology and Science* 3, no. 3 (2005): 283, doi:10.1080/14746700500317271.

³⁷ Cf. the subtitle of Polanyi, *Personal knowledge*: "Towards a post-critical philosophy".

³⁸ Losch, "Our world is more than physics," 282.

³⁹ Ian G. Barbour, *Religion in an age of Science*, 1. publ, The Gifford lectures 1989-1991, 1 (London: SCM Press, 1990), 34.

⁴⁰ Thomas S. Kuhn, *The structure of scientific revolutions*, 2nd ed. (Chicago: Chicago University Press, 1970), 44.

⁴¹ Ernst von Glasersfeld, *Radical constructivism: A way of knowing and learning*, Studies in mathematics education series 6 (London, New York: Routledge/Falmer, 2002), 14. *My italics*.

⁴² *Ibid.*, 15.

⁴³ *Ibid.*, 18.

⁴⁴ See Losch, "Our world is more than physics" Losch, "Critical Realism—A Sustainable Bridge Between Science and Religion?"

⁴⁵ Glasersfeld, *Radical constructivism*, 14

⁴⁶ Philip Hefner, "Biocultural Evolution and the Created Co-Creator," in *Science and theology: The new consonance*, ed. Ted Peters (Boulder, Colo.: Westview Press, 1998), 175.

⁴⁷ Cf. Michael Welker, "Creation: Big Bang or the Work of Seven Days?," *Theology Today*, July (1995).

⁴⁸ H. Richard Niebuhr, *The responsible self: An essay in Christian moral philosophy*, 1st ed. (New York: Harper & Row, 1963).

⁴⁹ Reinhold Niebuhr, *Faith and politics: A commentary on religious, social, and political thought in a technological age* (New York: Braziller, 1968).

⁵⁰ Ian G. Barbour, *Ethics in an age of technology*, 1. HarperCollins ed., 2. [print.], The Gifford lectures 1989-1991, 2 (New York NY: HarperSanFrancisco, 1994); Ian G. Barbour, *Nature, human nature and God*, Theology and the sciences (Minneapolis Minn.: Fortress Press, 2002).

⁵¹ Ernan McMullin, "Realism in Theology and Science: A Response to Peacocke," *Religion & Intellectual Life*, 2/4 (1985).

⁵² Losch, "Our world is more than physics," 286.

⁵³ Blaise Pascal and T. S. Eliot, *Pascal's Pensées*, Dutton DEP paperback D18 (New York: E.P. Dutton, 1958), 149.